REMARKS

Claim 4 has been canceled. Claims 1, 2, 5, 6, 9-12, 15, 17, 19 and 20 and new Claims 21 and 22 remain active in the case. Reconsideration is respectfully requested.

The present invention relates to a method of producing a sintered silicon nitride filter.

Claim Amendments

Claim 1 has been amended by incorporating the limitation of Claim 4 therein and by the including a limitation of the average pore diameter of 5 to 40 μm disclosed in the third paragraph of page 12 of the specification. Further, the atmosphere in which a green body based on silicon nitride is heat treated is defined as one of two types which are an atmosphere consisting essentially of nitrogen and an atmosphere consisting essentially of an inert gas and nitrogen at a partial pressure of at least 50 kPa. These atmospheres are essentially oxygen free meaning that if any oxygen were to be present in either atmosphere, for the purposes of the present invention, the oxygen can not result in an altered sintered silicon nitride product that would contain some amount of oxygen which in any way fails to meet the objective of the invention of providing an effective filter for the filtering of diesel fuel. The same amendment to the atmosphere of Claim 9 has been made, and the nitrogen atmosphere of Claim 20 should also be understood in this manner of consisting essentially of nitrogen. The amendment of the scope of the atmosphere of the claims is fully supported by the first paragraph of page 12 of the text. Entry of the amendments is respectfully requested.

New Claim 21 is supported by Claim 5 while new Claim 22 is supported by Claim 19. Entry of the new claims is respectfully requested.

Claim Rejection, 35 USC 112, First Paragraph

Applicants submit that the amendments made to Claim 1 are sufficient to obviate the issue raised under the first paragraph of 35 USC 112. The claims clearly recite two different nitrogen base atmospheres which are an atmosphere consisting essentially of nitrogen and an atmosphere consisting essentially of nitrogen and another inert gas wherein the nitrogen component of the atmosphere has a partial pressure of at least 50 kPa. These definitions are clearly supported by the disclosure of the first paragraph on page 12 of the specification. The atmosphere under which sintering is conducted must be essentially free of oxygen otherwise silicon nitride will be converted to silicon oxide to the detriment of the silicon nitride product obtained. (See the description of the paragraph bridging pages 7 and 8 of the text.) Accordingly, the issue which has been raised under 35 USC 112 is believed obviated and withdrawal of the same is respectfully requested.

Invention

As claimed in the embodiment of the invention as claimed in Claim 1, a sintered silicon nitride filter is produced by heat-treating, in a nitrogen atmosphere containing no oxygen, a green body comprising from 35 to 90 wt % of silicon nitride particles having an average particle diameter of from 1 to 30μm, from 5 to 60 wt % of a pore-forming agent of spherical organic polymer particles selected from the group consisting of a polyvinyl alcohol, an acrylic resin, a vinyl acetate resin or cellulose ranging in size from 20 to 100 μm and from 0.1 to 5 wt % of metal oxide solid particles, provided that the total amount of the silicon nitride particles, the pore-forming agent and the metal oxide particles is at least 90 wt %, to

form a porous product that is effectively useful as a filter for diesel fuel particulates.

Claim 9 is directed to the embodiment of the invention that is a method for producing a silicon nitride filter by heat-treating, in an atmosphere containing substantially only nitrogen to one that contains no oxygen, a green body that is constituted of from 45 to 85 wt % of silicon nitride particles having an average particle diameter of from 1 to 30μm, from 10 to 50 wt % of metal oxide hollow particles, and from 0.1 to 5 wt % of metal oxide solid particles, provided that the total amount of the silicon nitride particles, the metal oxide hollow particles and the metal oxide solid particles is at least 90 wt %, to form a porous product and having a porosity of 30 to 80 % and an average pore diameter as measured by a mercury immersion method of from 5 to 40 μm which effectively filters particulate matter from diesel fuel.

Prior Art Rejection

The Niwa et al patent, as stated previously, discloses a porous ceramic product that possesses thermal shock resistance. The product is prepared by heating a raw material ceramic powder that is selected from a group of materials including silicon nitride. In the thermal process of forming the porous ceramic product, hollow oxide particulate material is used as the means of introducing porosity into the ceramic product obtained. The sintered product obtained is used as a valve unit that has high durability. The claims of the present invention, however, are clearly distinguished over the reference on the basis that the silicon nitride filter is directed to the specific aspect of being effective in the **filtering of particulates from diesel fuel**. A point to be made is that the sintered ceramic body of the

reference that is useful as a mechanically working device, i.e., a valve unit of a faucet, must have certain strength characteristics to function mechanically in the intended manner. On the other hand, because the silicon nitride product of the present invention functions as a filter, it does not have to have the mechanical properties of the ceramic of the patent, but clearly must have an established degree of porosity if it is to effectively function as a filter. Accordingly, the present claims recited that the porosity of the silicon nitride product must range from 30 to 80 % and that the ave pore diameter must range from 5 to 40 μm, preferably from 5 to 20 μm. On the other hand, applicants submit that the teachings of the reference as to porosity and ave pore diameter in the patent do not lead one of skill to the porosity/ave pore diameter combination of the present claims. That is, at the most, there is only a 10 % overlap of porosity ranges of the present claims and the disclosure of the reference, which overlap disappears at the preferred porosity of the ceramic of the patent at 2 to 20 %. Further, this overlap is in the context of an ave pore diameter in the patent of 5 to 300 μm, preferably 20 to 250 μm, while in the invention the ave pore diameter must range as described above. (Note that inconsistency exists in the disclosure of ave pore diameter in the reference between the proclaimed range of 5 to 300 μm and the commentary in the paragraph bridging columns 4 and 5 where it is stated that the ave pore diameter is larger than the ave particle sizes of the hollow particles of 20 to 250 μm and the ceramic particles of 1 to 20 μm, meaning that at a minimum the ave pore diameter of the ceramic product must be greater than 21 μm at a minimum. This is inconsistent with the disclosed range of 5 to 300 μm.) Thus, the reference is not believed to suggest the ave pore diameter/porosity limitation of the present claims.

Applicants again maintain that an important distinction between the present process as claimed in Claim 1 and the patent is that the pore-forming substance is spherical organic polymer particles of a size ranging from 20 to 100 μm, whereas the patent clearly teaches hollow metal oxide particles as the pore forming agent. The particles are disclosed as having a size in the range from 20 to 250 μm order to introduce the appropriate porosity into the product. In fact, the patent teaches in the Experiment of columns 8 and 9 and in Table 1 that hollow metal oxide particles produce a product that is superior for the purposes of the patent in producing a valve unit than the use of various resin particles of about 100 μm in size in producing a ceramic product. This fact is demonstrated by the sliding durability data and the thermal shock resistance data of Table 1. On the other hand, for the purposes of the present invention of producing a silicon nitride product where porosity and ave pore diameter are important as factors in the use of the product as a filter, the use of certain resin particles of the size range stated is acceptable. Thus, the use of certain resin particles as a component of a green body to produce the article of the present invention is quite satisfactory, which is something that one of skill in the art would not perceive from the disclosure of Niwa et al. Accordingly, the patent does not teach or suggest the method embodiments of the invention.

While the Apte et al patent discloses various organic materials as pore forming agents, nevertheless it is clear from the fact that Niwa et al teaches that particulate organic materials are **unsatisfactory** as pore forming materials, that one of skill would not use the organic materials taught by Apte et al in the method of Niwa et al. Moreover, the ceramic preform of the patent which has a graded microporosity and has a metal activator embedded therein is clearly not useful as a filter of the likes of diesel fuel and therefore the preform of

the patent does not meet the porosity and ave pore diameter limitations of the present claims. Accordingly, the combined references do not suggest the process of present Claim 1.

As to the method of Claim 9 wherein a component of the materials that are used to form the green body that is subsequently heat treated to form a porous silicon nitride product is hollow metal oxide particles, neither reference teaches or suggests the combination of porosity and ave pore diameter features that is necessary to form a silicon nitride body that has useful liquid filtering characteristics.

As to Watanabe et al, which discloses silicon nitride sintering temperatures, such disclosure is pertinent to a secondary aspect of the claimed invention upon which patentability does not depend. Accordingly, withdrawal of the rejection over the combined three patents of record of Claims 6 and 15 which depend upon patentable claims is respectfully requested.

It is believed that the application is in condition for consideration on its merits.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER AND NEUSTADT, P.C.

Norman F. Oblon
Registration No. 24,618
Attorney of Record

Frederick D. Vastine
Registration No. 27,013

Customer Number
22850

(703) 413-3000
(703) 413-2220 (fax)

NFO/FDV